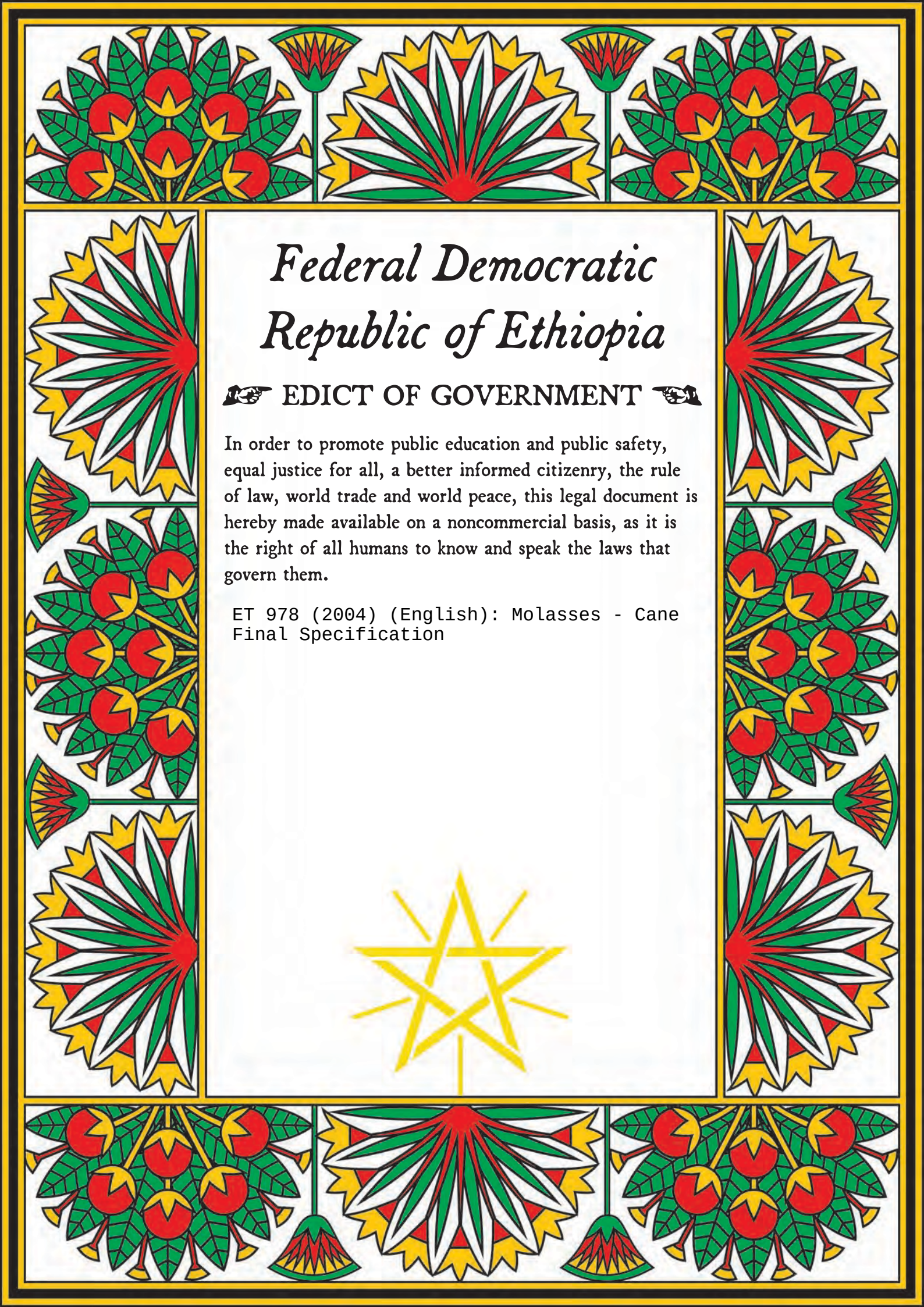




Federal Democratic Republic of Ethiopia

✎ EDICT OF GOVERNMENT ✎

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ET 978 (2004) (English): Molasses - Cane
Final Specification



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Molasses - Cane Final Specification

ICS: 67.180.10

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Foreword

This Ethiopian Standard has been prepared under the direction of the Technical Committee for Sugar and Sugar Products (TC 22) and published by the Ethiopian Standards Agency (ESA).

The standard is a reaffirmation for reprint of the Ethiopian Standard ES 978:2004, Molasses - Cane Final Specification, with some editorial changes without altering the technical contents in the former text.

Molasses - Cane final specification

1 Scope

This Ethiopian Standard specifies the requirements method of test and sampling for cane final molasses.

2 Definitions

For the purpose of this Ethiopian Standard the following definitions shall apply.

2.1

Molasses

shall mean the syrupy juice of the cane after most of the water and all or any part of the commercially crystallizable sugar has been removed.

2.2

Brix

the percentage by weight of solid matter in solution

3 Requirements

3.1 General

The material shall be dark colored viscous, syrupy liquid having a characteristic odor.

Molasses shall comply with the requirements of the following table.

Table I: Showing Requirements for Cane Molasses.

Ser. No	Characteristics	Requirements	Test methods
1	Degree brix at 20°c min, (Refractometer Brix)	85	Annex A
2	Apparent Sucrose, % mass max	35	Annex B
3	Total reducing matter as invert sugar. % mass max.	50	Annex C
4	Reducing sugar, % by mass max.	14	Annex D
5	Sulphated ash % by mass, max.	14	Annex E
6	Un fermentable substance as inverted sugar % by mass max.	3	Annex F

4 Packing and labeling

4.1 Bulk delivery :The material shall be delivered in bulk in tankers.

4.2 Delivery in containers: The material shall be packed in clean, dry, corrosive resistant and leak - proof

containers.

5 Labeling

5.1 each container shall be suitably labeled so as to give the following information

Name of the material
Name and address of the manufactures
Net weight of the material

6 Sampling of cane molasses

6.1. In drawing, preparing, storing and handling test samples, the following precautions and directions shall be taken.

6.2 The sampling instrument shall be clean and dry when used.

6.3 The samples, the material being sampled the sampling instrument and the containers for samples shall be protected from adventitious contamination.

6.4 To draw a representative sample, the contents of each container selected for sampling shall be mixed as thoroughly possible by shaking or stilling or both, or by rolling so as to bring all portions into uniform distribution.

6.5 The sample shall be placed in suitable clean, dry and air-tight metal or glass containers, on which the material has no action

6.6 The sample containers shall be of such a size that they are almost, but not completely, filled by the sample.

6.7 Each sample container shall be sealed airtight and marked with full details of sampling and the date of sampling.

6.8 Sampling can: Consists of a weighted metal cylinder with removable top, to which a rod is attached (see Fig.1).

The cylinder is fasted to suitable rod. For tacking a sample, it is lowered in the tank to the required depth, and the top is removed with the help of the rod and the can then filled.

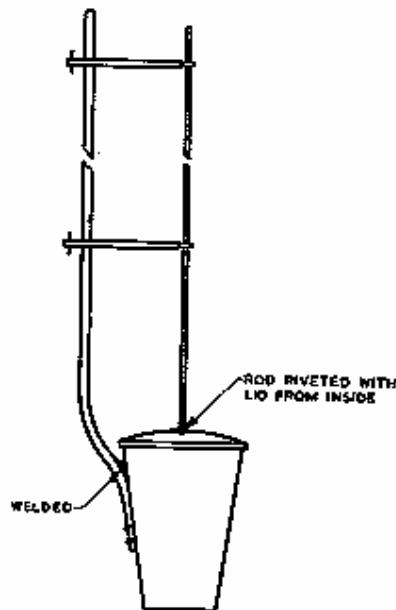


FIG. 1 SAMPLING CAN FOR TANK/TANKER

4.8.1 For other containers, the sampling device of the design shown in figure 2 may be used.



FIG. 2 SAMPLING DEVICE FOR CONTAINERS

6.9 Scale of Sampling

6.9.1 Supply in Tank/Tankers

Samples shall be drawn from each cane/tanker as follows.

Equal portions of the material shall be taken from different layers of the tank/tanker with the help of the sampling can to obtain a composite sample not less than 2.5 liters and mixed thoroughly in a suitable container.

Divide this composite sample into three equal portions of not less than 750 ml in dried bottles or other containers, seal airtight and label with all the particulars of the sample.

6.9.2 Supply in containers

All the containers in a single consignment shall constitute one lot.

4.9.3 Gross sample. For the purpose of drawing samples for test a number of containers shall be selected at random from a lot. The number of containers in relation to the size of the lot or scale of sampling shall be as in the following table.

Table II: Showing the minimum number of containers to be selected for sampling from various sizes of lots.

Lot size	Sample size
2 to 8	2
9 to 27	3
28 to 64	4
65 to 125	5
126 to 216	6
217 to 343	7
344 to 512	8
513 to 729	9
730 to 1000	10
1001 to 1331	11

6.10 Sampling from containers

6.10.1 Mix thoroughly the contents of all the containers in the gross sample whether they are drums or cans of other, by shaking or stirring or both, or by rolling so as to bring all portions into uniform distribution.

6.10.2 Drawing Samples: Samples shall be drawn by inserting the sampling device thorough the bung hole any other convenient opening equal portions of the well-mixed material from each container in the gross sample shall be taken so as to obtain a quantity not less than 2.5 liters. The composite sample thus obtained shall be divided into three equal portions of not less than 750 ml in dried bottles or other containers, sealed airtight and labeled with all the particulars of the sample.

6.10.3 Reference sample: The third sample bearing the seals of sampler and the producer shall be kept in appropriate place to be used in the case of dispute.

6.10.4 Time limit for analysis: All samples shall be tested with in two months from the date of sampling.

6.10.5 Criterion for acceptance: If on testing, the sample is found to conform to the requirements specified in the standard, the consignment shall be accepted.

Annex A

(normative)

Determination of degree brix at 20°C

A1 Principles

Aqueous solution of the molasses is measured by refract meter and the instrument reading is converted to brix at 20°C from a table.

A2 Apparatus

- A2.1 Beaker 12, capacity
- A2.2 Funnel stem less,
- A2.3 Filter paper what man No. 91 or equivalent
- A2.4 Precision refractometer
- A2.5 Balance
- A2.6 Glass rod
- A2.7 Watch glass
- A2.8 Beaker 150 ml
- A2.9 Thermometer range 0-50°C

A3 Procedure

- A3.1 Weight out 100g of well mixed sample in a 1L beaker. Bring to 600.g by adding distilled water. Stir with glass rod until completely dissolved
- A3.2 Filter through a fluted what man No. 91 filter paper, covering the funnel with a watch glass to minimize evaporation.
- A3.3 Reject the first 20 ml of filtrate collect sufficient filtrate (about 100 ms) in a 150 ml beaker for determination of refractometric brix at 20°C.
- A3.4 Bring temperature of the molasses solution to 20°C using water bath thermostatically controlled. Check the temperature-using thermometer.
- A3.5 Read the refractive index of the solution at 20°C and convert the instrument reading to Brix at 20°C from table G

Annex B

(normative)

Determination of Apparent sucrose

B1 Scope

This method is applicable to measure apparent sucrose in cane molasses.

B2 Principle

Sucrose content of molasses is measured by direct polarization before and after acid hydrolysis.

B3 Apparatus

B3.1 Polarimeter or saccharimeter calibrated in sugar degree (0_Z)

B3.2 Polarimeter tube 200 mm or 100 mm in length

B3.3 Analytical balance: Readable to 1 mg

B3.4 Funnel and Filtrate receiver

B3.5 Water bath - maintained at $69.0 \pm 0.5^\circ\text{C}$

B3.6 Thermometer - range $0-100^\circ\text{C}$

B3.7 Water bath maintained at $20^\circ\text{C} \pm 0.5^\circ\text{C}$

B3.8 Fast filter paper what man No. 541 or equivalent.

B4 Reagents

B4.1 Basic lead acetate solution:

Dissolve 450 g of basic lead acetate in about 1 liter of distilled water. Boil for about 30 minutes and allow to settle. Decant the supernatant liquid and dilute to 1.24 specific gravity or 24.4 g pbo/100ml total lead content with recently boiled distilled water. Check the total lead content either by measuring the specific gravity or titrimetrically. The total lead specification calls for a specific gravity of 1.24 ± 0.01 or a total lead content of $24.4 \pm 1\text{g PbO}/100\text{ ml}$. The basic lead content must be between 9.5 and 10.5 gram PbO/100 ms. if the quantity of basic lead lies above this range adjust by adding glacial acetic acid. After adjustment determine the total and basic lead contents. Keep the solution in airtight container to avoid any contact with CO_2

Flush the container with nitrogen gas before closing.

B4.2 Potassium Oxalate or Sodium Oxalate

B4.3 Hydrochloric acid solution, Approximately 2.5N prepare by tacking 215 ml of concentrated Hydrochloric acid specific gravity of 1.18 g/ml at 20°C and make up with water to a volume of 1 liter.

B4.4 Zinc powder

B4.5 Diatomaceous earth filter aid

B5 Procedure

B5.1 Weigh out a 65.000 ± 0.002 g well mixed sample and transfer without loss to a 500 ml volumetric flask with aid of approximately 100 ml of distilled water and made up the volume to 150 ml and mix the solution by swirling the flask.

B5.2 Add 40 ml of basic lead acetate solution and mix by swirling.

Make the solution up to the volume with distilled water and shake gently.

B5.3 Filter the solution and reject the first 10 ml of the filtrate and collect at least 100 ml of filtrate.

B5.4 Add sufficient dry potassium oxalate or sodium oxalate with stirring to the filtrate to completely precipitate the excess lead.

B5.5 Filter the mixture rejecting the first 10 ml of filtrate. If the filtrate remains cloudy it may be necessary to use a small quantity of diatomaceous earth to aid filtration.

B5.6 Pipette 50 ml of the filtrate in to a 100 ml volumetric flask. Make up to volume at $20.0 \pm 0.5^\circ\text{C}$. Read the polarization P in a 200 mm Polarimeter tube. 100 ml tube may be used for darker solutions. Record the temperature at which readings were taken.

B5.7 Pipette a further 50 ml of the filtrate in to a 100 ml volumetric flask and add 23 ml of 2.5 N hydrochloric acid and 7 ml water.

B5.8 Insert a thermometer in to the flask and place the flask into the water bath at 69°C . Swirl the flask in the water bath for 5 minutes timed from the moment the contents reach $65.0 \pm 0.5^\circ\text{C}$.

B5.9 Remove the flask from the water bath and cool rapidly under cold running water. Remove the thermometer from the flask rinsing it carefully into the flask with water. Make the volume up to 100 ml at 20°C .

B5.10 Read the polarization I in a 200 mm tube. Dark solutions may be decolorized by the addition of 0.5 to 1.0 g of zinc powder. Very dark solutions may be diluted or read in a 100 mm tube.

If dilution is required pipette 50 ml into a 100 ml volumetric flask and make up to volume. No other dilution should be used. Note the temperature, which should be the same as that at which the direct polarization p was determined.

B5.11 Calculation

The following formula is used to calculate apparent sucrose content.

$$\text{Apparent sucrose, \%mass,} = \frac{100 (P - I)}{132.66 - 0.5(t - 20)}$$

Where,

P= is the polarization value before inversion

(P x 4) for a 200 mm tube

(P x 8) for a 100 mm tube

I= is the polarization value after inversion

(I x 4) for a 200 mm tube

(I x 8) for a 100 mm tube

t= is the temperature $^\circ\text{C}$ at which the readings were taken.

Annex C

(normative)

Determination of total reducing sugars

C1 Scope

This test method is applicable to all samples of molasses

C2 Definitions

C2.1

Reducing sugars in molasses

shall mean after hydrolysis are primarily, but not exclusively, glucose and fructose

C2.2

Invert

shall mean an equimolar mixture of glucose and fructose

C3 Principles

The method relies upon the property of reducing sugars to reduce Fehling's solution under standard conditions.

C4 Apparatus

C4.1 Volumetric flasks

C4.2 Thermometers

C4.3 Hot plate thermostatically controlled

C4.4 Analytical balance

C4.5 Weighing dish

C4.6 Timer- indicating minutes and seconds

C4.7 Erlenmeyer flask Pyrex 300 ml capacity

C4.8 Funnel

C4.9 Water bath maintained at $60 \pm 1^\circ\text{C}$ and $20 \pm 1^\circ\text{C}$

C5 Reagents

C5.1 Hydrochloric acid concentrated, Sp.g 1.18 g/ml

C5.2 Benzoic acid

C5.3 Methylene blue solution 1g/100 ml. Dissolve 1g of methylene blue in water and make up to volume of 100 ml.

C5.4 Sodium hydroxide solution, 2 Normal dissolve 80 g of sodium hydroxide in approximately 500 ml water. Cool the solution transfer to 11 volumetric flask and make up to volume with water.

C5.5 Sodium hydroxide solution, App. 1N/L weigh 40g of sodium hydroxide dissolve it in small amount of water in volumetric flask and dilute it to one liter

C5.6 Hydrochloric acid 6.34 N Sp.g 1.109 g/ms. Most conveniently prepared by diluting the concentrated acid with an equal volume water. The density should be determined and necessary adjustment made by the addition of extra acid or water.

C5.7 Hydrochloric acid, approximately 0.5N. Dilute 44.5ml of concentrated hydrochloric acid to 1 litre

C5.8 EDTA disodium salt solution. Dissolve 20g in water and make the volume up to 500 ml.

C5.9 Liquid paraffin to act as anti foam, or any other anti foam, which does not reduce Fehling's solution.

C5.10 Phenolphthalein solution 1 g/100 ml. Dissolve 1 g of phenolphthalein in 60 ml of denatured alcohol and made up to a volume of 100 ml with water.

C5.11 Standard invert solution: 2.5 g/L. Weigh 9.50 g of sucrose and transfer carefully to a 1L volumetric flask with aid of 100 $\pm$ 5 ml of water

C5.11.1 Add 5 ml of concentrated hydrochloric acid to the sucrose solution mix gently during the addition and properly stopper and store it for 4 days at a temperature of 20-25°C or 8 days at 12-15°C.

C5.11.2 Dilute the invert solution with water to approximately 800 ml.

C5.11.3 Dissolve approximately 2 g of benzoic acid in 75 ml of hot water and add the benzoic acid solution to the invert solution. Finally make the solution volume to 12 at 20°C and mix, thus producing a 10 g/L invert solution. If properly stopper this solution remains stable for at least 6 months.

C5.11.4 Prepare a neutral 2.5 g/L standard invert solution by pipetting 50 ml of the 10 g/L invert solution in to 200 ml volumetric flask. Add two drops of phenolphthalein solution. Add sodium hydroxide solution 1N with gentle agitation until a pink color develops. Discharge the pink color of the invert solution by the addition of one or two drops of 0.5N hydrochloric acid solution. Make the solution up to the volume with water and mix. This solution should be prepared immediately prior to use.

C5.12 Fehling's solution

C5.12.1 Copper solution (solution A) Dissolve 34.64 gram of copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in water. Transfer the solution, with out loss, to a 500 ml volumetric flask, make up to volume at 20°C with water and mix. If necessary, filter through an inert filter medium porous ceramic or sintered glass.

C5.12.2 Alkaline Tartarate solution (solution B). Dissolve 173.045 gram of Rochelle salt (potassium sodium tartarate) $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$ and 50 gram of sodium hydroxide in water. Dilute to 500 ml.

C5.12.3 Mixed Fehling's solution: Mix together equal volumes solution A and solution B by pouring solution A in to solution B whilst stirring with a glass rod. Filter if necessary and store in suitable stoppered container.

C5.12.4 Standardization of Fehling's solution.

Adjust the heating appliance so that 75 ml of water contained in the boiling flask boiling in a period of 2.5 min. $\pm$ 5 sec.

Rinse and Fill a 50 ml burette with the 2.5 g/L standard invert solution and fill another 50 ml burette with water.

Pipette 20 ml of the mixed Fehling's solution in to the boiling flask and add from the burette giving a total volume of 74 ml. Add a small quantity of boiling chips and a few drops of antifoam. Mix the solution gently.

Place the flask on the heating appliance and allow the solution to reach the boiling point. Start the timer and allow

the solution to boil for precisely 2 minutes. Add 4 drops of methylene blue solution. Complete the titration by slow addition of the invert solution from the burette.

Add the invert solution in small increments, which are progressively reduced starting with additions of 0.2 ml then 0.1 ml and finally drop wise. Complete the titration at the end of 1 minute from the time the methylene blue solution was added ± 5 sec. This gives a total boiling time of 3.0 minutes ± 5 second. The end point of the test is denoted by the absence of the blue color imparted by the precipitated cuprous oxide. Repeat the test if necessary in order to reach the end point after the correct interval. At no time during the test should the flask be removed from the source of the heater shaken.

Record the titre. If Fehling's solution is of the correct strength 20 ml should require 40.0 ml of the invert solution giving a total solution volume of 75 ml. If the titre is less than 40.0 ml or above adjustment should be made either by adding copper sulphate or diluting with water. After any adjustments have been made carry out standardization procedure again.

When Fehling's solution is of the correct strength then 20 ml is equivalent to 100 mg of invert sugar.

C6 Procedure

C6.1 Preparation of hydrolysed molasses solution

C6.1.1. First prepare a 50 g/L molasses solution. Weigh as rapidly as possible in to clean weighed beaker 10. ± 0.2 g of sample.

C6.1.2 Add approximately 15 ml of water to the sample and mix thoroughly with a glass rod. Transfer the solution without loss, to a 200 ml volumetric flask, Rinse the rod and the beaker with successive additions of water and add the washings to the flask contents.

C6.1.3 Add water to bring the volume up to 90 ml and swirl the flask to mix the solution. Finally make the volume up to 200 ml at 20°C and mix to give 50°C and mix to give 50 g/L solution of molasses.

C6.1.4 Pipette 25 ml of the molasses solution in to a 250 ml volumetric flask. Add 5 ml of the 6.34 N Hydrochloric acid from a 25 ml burette mix gently.

C6.1.5 Immerse the flask in the water bath at 60°C and swirl gently for 3 minutes to raise the temperature of the sample as rapidly as possible. Allow the flask to stand in the water bath for further 12 minutes. During the standing period do not allow the flask to contact any part of the heating surface of the water bath.

C6.1.6 Remove the flask from the water bath and cool rapidly by holding the flask in cold running water. Dilute the solution to approximately 125 ml with water and add a few drops of phenolphthalein solution. Then add sufficient 2N sodium hydroxide solution to impart a reddish color to the solution. During the addition of alkaline the solution should be gently agitated. Discharge the red color of the solution by adding a few drops of 0.5N hydrochloric.

C6.1.7 Add 4.0 ml of the EDTA solution; mix well and make up to the volume with water at 20°C. The solution is equivalent to 0.5 g molasses per 100 ml.

C6.2 Titration

C6.2.1 Ensure that the heating appliance is operating under the prescribed conditions and rinse and fill the burette with the hydrolyzed molasses solution. Take another burette, fill with water and carry out the preliminary test.

C6.2.2 Pipette 20 ml Fehling's solution in the boiling flask, run in to 20 ml of the hydrolyzed molasses solution and add small quantity of boiling chips.

C6.2.3 Place the flask on the heater, allow the solution to reach boiling point and add 4 drops of the methylene blue solution.

C6.2.4 Proceed the titration by initially adding increments of 2 ml of molasses solution and progressively reducing the additions down to 0.2 ml and attempting to obtain the end point in about 1 minute from the time the solution commences boiling. The end point is denoted by the disappearance of the blue color and imparted by the precipitated cuprous oxide. Record the titre.

C6.2.5 Carry out a further test adding to the boiling flask, 20 ml of Fehlings solution, the volume of hydrolyzed molasses solution obtained from the first titration less 0.5 ml and sufficient water from the burette to give a volume of 75 ml. After 2 minutes boiling add four drops of methylene blue and complete the titration by adding the hydrolyne blue and complete the titration by adding the hydrolyzed molasses solution, initially with 0.1 ml increments and finally drop wise.

C6.2.6 The titration should be completed at the end of one minute $\pm$ 0.5 second. Record the titre. Use this titre for the calculation of the total reducing sugars.

C6.2.7 Calculations

The total reducing sugars concentration after hydrolysis in the molasses is given by:

$$\text{Percent total reducing sugars (as invert sugar)} = \frac{1000}{CXT}$$

Where,

C= Concentration of molasses test solution (g/100 ml)

T= Titre (ml of molasses solution used)

Annex D

(normative)

Determination of reducing sugars.

D1 Scope

This test method is applicable to cane molasses containing reducing sugars in the range 10 to 25%.

D2. Principles

The method relies up on the property of reducing sugars to reduce Fehling's solution under standard conditions .

D3 Definitions

The following definitions shall apply to this test method.

D3.1

Reducing sugars

shall mean primarily glucose and fructose present in molasses.

Invert equimolar mixture of glucose and fructose

D3.2

Cane molasses

shall mean a by-product of either raw cane sugar manufacture or refining. It is a dark heavy viscous liquid from which no further sugar cane be crystallized by normal methods.

D4. Apparatus

D4.1 Volumetric flasks

D4.2 Thermometers

D4.3 Hot plate thermostatically controlled.

D4.4 Analytical balance

D4.5 Weighting dish

D4.6 Timer - indicating minutes and seconds

D4.7 Erlenmeyer flask Pyrex 300 ml capacity

D4.8 Funnel

D4.9 Water bath maintained at $20 \pm 1^{\circ}\text{C}$.

D5 Reagents

D5.1 Hydrochloric acid concentrated $\text{Sp}_{20}=1.18 \text{ g/ml}$.

D5.2 Benzoic acid

D5.3 Methylene blue solution 1g/100 ml. Dissolve 1g of methylene blue in water and make up to a volume of 100 ml.

D5.4 Sodium hydroxide solution 1N

D5.5 Hydrochloric acid 0.5N.

D5.6 EDTA disodium salt 40 g/l. Dissolve 20 gram of EDTA in water and make up the volume up to 500 ml.

D5.7 Liquid paraffin antifoaming agent.

D5.8 Phenolphthalein solution 1g/100 ml. Dissolve 1 g of phenolphthalein in 60 ml of denatured alcohol and make up to a volume of 100 ml with water.

D5.9 Standard invert solution prepare as in ES 985 annex C4.

D5.10 Fehling's solution

Prepare Fehling's solution as in ES 985 annex C

D5.11 Standardization of Fehling's solution standardize Fehling's solution as prescribed in ES 985 annex C

D6 Procedure

D6.1 Sample solution: Weigh as rapidly as possible in to clean weight beaker 10 ± 0.2 g of sample.

D6.2 Add approximately 15 ms of water to the sample and mix thoroughly with glass rod. Transfer the solution, with out loss, to a 200 ml volumetric flask. Rinse the rod and dish with successive additions of water and add the washings to the flask contents.

D6.3 Add sufficient water to bring the volume up to 90 ml and swirl the flask to mix the solution. Finally make the volume up to 200 ml at 20oc and mix to give 50 g/L solution of molasses.

D6.4 prepare a 20 g/L solution of the sample by pipetting 100 ml of the molasses solution into a 250 ml volumetric flask and add 15 ml of the EDTA solution. Mix the solution and make up to the volume at 20oc and mix again.

D6.5 Titration

D6.5.1 Ensure that the heating appliance is operating as prescribed in ES 985 annex C and then rinse and fill the burette with the 20 g/L solution. Take another burette, fill with water and carry out the preliminary test.

D6.5.2 Pipette 20 ml of the Fehling's solution into the boiling flask, run in 20 ml of the molasses solution, add few granules of boiling chips and few drops of antifoams.

D6.5.3 Place the flask on the heating appliance, allow the solution to reach the boiling point and add 4 drops of methylene blue solution.

D6.5.4 Titrate by initially adding increments of 2 ml of the molasses solution and progressively reducing the additions down to 0.2 ml and attempting to obtain the end point in about 1 minute from the time the solution commences boiling. The end point is denoted by the absence of blue colour and imparted by the precipitated cuprous oxide. Record the titre.

D6.5.5. Carry out a further test adding to the boiling flask 10 ml of Fehling's solution; the volume of molasses obtained from the first titration less 0.5 ml and sufficient water from the burette to give a volume of 75 ml. After 2 minutes boiling add 4 drops of methylene blue and complete the titration initially with 0.1 ml increments and finally drop wise. The titration should be completed at the end of a further 1 minute ± 0.5 second, Record the titre and use it to calculate the reducing sugars.

D6.5.6 Calculations

Since 20 ml of Fehling's solution is equivalent to 100 mg of inverse sugar the reducing sugars content is:

$$\text{Reducing sugars, \% m/m} = \frac{10000 \times F}{TC}$$

Where,

F= Sucrose factor form the table below

C= Concentration of sample in solution (g/L)

T= titre (ml)

Sucrose present in test volume of solution	Factor (F)
0.0	1.0000
0.5	0.988
1.0	0.975
2.0	0.950
3.0	0.934
4.0	0.917
5.0	0.906
6.0	0.894
7.0	0.884
8.0	0.874
9.0	0.865
10.0	0.856

Annex E

(normative)

Determination of sulphated ash

E1 Scope

This test method is applicable to all samples of molasses

E2 Principles

The ash is determined and the result expressed as sulphated ash after successive incinerations at 550°C and 650°C with sulphuric acid.

E3 Apparatus

E3.1 Platinum, or quartz crucible with a capacity of 50 ml and minimum working surface of 15cm² which may depend upon the product being analyzed.

E3.2 Electric muffle furnace maintained at 500-650°C ± 25°C

E3.3 Hot plate or Bunsen burner

E3.4 Desiccators

E3.5 Analytical balance readable to 0.1 mg

E4 Reagents

E4.1 Distilled water conductivity of less than 2 mg/cm

E4.2 Sulphuric acid solution: carefully add 100 ml of concentrated sulphuric acid (Sp.g 1.84 mg/ml) to 300 ml of water and mix.

E4.3 Hydrochloric acid solution: Carefully add 100 ml of concentrated hydrochloric acid (Sp 1.18 g/ms) to 500 ml of water and mix.

E5 Procedure

E5.1 Use a well ventilated fume cupboard for all steps creating fumes.

E5.2 Preparation of the dish

E5.2.1 Clean the dish with boiling hydrochloric acid solution and rinse thoroughly with water. After Heating it in the furnace at 550°C, allow it to cool in a desiccators and weigh to ± 0.2 mg.

E5.3 Preparation of test sample.

E5.3.1 In order to start with a representative homogenous solution weigh out 50.0 gram sample and add

water to 100 g to give a 1:1 w/w solution. After the sample has been mixed well, possibly warm the sample at a temperature of 60°C in a water bath to facilitate mixing; weigh out at least 10 g to within ± 1 mg. Add equal quantity of water and mix after a further gentle reheating. Use closed containers or make up after cooling any water lost by evaporation. This gives solution A.

E5.3.2 Weigh out 10 g of solution A to ± 0.001 g in the crucible and add 2 ml of sulphuric acid.

E5.3.3 Heat the crucible on an electric hot plate or Bunsen burner in a fume cupboard until the sample is Completely carbonized.

E5.3.4 Place the crucible in a muffle furnace at 550°C for 2 hours. Remove and cool add 2 ml of

Sulphuric acid solution drop wise, allow this to evaporate on the hot plate or over Bunsen burner in a fume cupboard and incinerate at 650 °C for 30 minutes. Allow to cool in desiccator and weigh to ± 0.2 mg.

E5.4 Calculation

The weight of residual ash is expressed as a percentage sulphated as in the original

Sample

$$\text{Sulphated ash, percent by mass} = \frac{100 \times M_2 - M_0}{M_1}$$

Where,

M₀= Mass of empty crucible

M₁= Mass of the original sample (diluted to 1:1 at step E5.3.1)

M₂= Mass of the residue and crucible.

Annex F

(normative)

Determination of non fermentable substance

F1 scope

This method is applicable to cane molasses

F2. Reagents

F2.1 Bakers yeast, free from starch. - May be stored for few days in refrigerator.

F2.2 Neutral lead acetate solution.-Dissolve 20 g lead acetate in water and dilute to 100 ml.

F2.3 Soxhlet modification of Fehling's solution. Prepare by mixing equal volumes of (a) and (b). Immediately before use.

a) Copper sulphate solution –Dissolve 34.639g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in water dilute to 500ml and filter through glass wool or paper.

b) Alkaline tartarate solution-Dissolve 173 g potassium sodium tartarate(Rochelle salt) and 50 g sodium hydroxide in water and dilute to 500ml. Let it stand for two days, and filter through inert filtering aid such as sintered glass.

F2.4 Potassium iodide solution. -Dissolve 20 g KI in water and dilute to 100 mL.

F2.5 Sodimthiosulfate solution.-0. 1N. accurately standardized.

F2.3 Fermentation

Transfer 12 g molasses to 500 ml volumetric. flask, using 75 ml water. Add 25 g fresh yeast, coarsely chopped, and mix thoroughly with molasses solution. Close flask with stopper provided with delivery tube, other end of which dips about 1 cm below surface of water in beaker; or use any other type of fermentation trap. Place flask in water bath kept at 30° and let ferment for 4 hr, shaking occasionally. (Incubator may be used and flask left overnight.)

When fermentation is complete, dilute the mixture with water clarify with 15 ml neutral lead acetate solution dilute to volume. at 20°C, add teaspoonful of Filter aid, or equivalent., shake well, and filter, discarding first few ml. Delead entire filtrate with 0.5 g anhydrous potassium oxalate and filter again with Filter aid Test filtrate for lead. If necessary, add additional potassium oxalate and refilter.

F2.4 Determination

Transfer 25 ml final filtrate to 250 ml Erlenmeyer flask, mix with 20 ml combined Soxhlet solution, and wash down wall of flask with 5 ml water, making 50 ml total. Add few pieces of anti bumping cheaps and place flask on wire gauze covered with asbestos plate that has center hole slightly smaller than bottom of flask. Heat with Bunsen burner, or, preferably, electric heater with temperature control. Heat to boiling in 3 min and boil gently exactly 2 min longer. Immediately close flask with stopper and cool quickly under tap water to prevent reoxidation. Add 15 ml potassium iodide solution and then 10 ml sulphuric acid (1 + 3). Titrate liberated Iodine at once with 0.1N sodium thioulphate, adding starch indicator toward end of titration.

Determine blank with 75 ml water instead of molasses solution, adding yeast, etc., as above. Deduct titer of sample from titer of blank.

and find mg invert sugar corresponding to difference from Table below. Result, divided by 4 gives directly % unfermentable reducing substances in the molasses, in terms of invert sugar.

Milligrams Invert Sugar Corresponding to 0.1N Sodiumthiosulfate solution.

0.1 N thiosulfate ml	Invert Sugar mg	0.1 N thiosulfate ml	Invert Sugar mg
1	3.2	14	47.3
2	6.4	15	50.8
3	9.7	16	54.3
4	13.0	17	58.0
5	16.4	18	61.8
6	19.8	19	65.5
7	23.2	20	69.4
8	26.5	21	73.3
9	29.9	22	77.2
10	33.4	23	81.2
11	36.8	24	85.2
12	40.3	25	89.2
13	43.8	-	-

Annex G

(normative)

Refractive Indices (*n*) of sucrose solutions at 20°—Continued.

<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %
1.3580	16.449	1.3630	19.503	1.3680	22.487	1.3730	25.403	1.3780	28.253
1.3581	16.511	1.3631	19.564	1.3681	22.546	1.3731	25.460	1.3781	28.310
1.3582	16.573	1.3632	19.624	1.3682	22.605	1.3732	25.518	1.3782	28.366
1.3583	16.634	1.3633	19.684	1.3683	22.664	1.3733	25.576	1.3783	28.422
1.3584	16.696	1.3634	19.745	1.3684	22.723	1.3734	25.633	1.3784	28.479
1.3585	16.758	1.3635	19.805	1.3685	22.781	1.3735	25.691	1.3785	28.535
1.3586	16.819	1.3636	19.865	1.3686	22.840	1.3736	25.748	1.3786	28.591
1.3587	16.881	1.3637	19.925	1.3687	22.899	1.3737	25.806	1.3787	28.648
1.3588	16.943	1.3638	19.985	1.3688	22.958	1.3738	25.863	1.3788	28.704
1.3589	17.004	1.3639	20.045	1.3689	23.017	1.3739	25.921	1.3789	28.760
1.3590	17.066	1.3640	20.106	1.3690	23.075	1.3740	25.978	1.3790	28.816
1.3591	17.127	1.3641	20.166	1.3691	23.134	1.3741	26.035	1.3791	28.872
1.3592	17.189	1.3642	20.226	1.3692	23.193	1.3742	26.093	1.3792	28.928
1.3593	17.250	1.3643	20.286	1.3693	23.251	1.3743	26.150	1.3793	28.984
1.3594	17.311	1.3644	20.346	1.3694	23.310	1.3744	26.207	1.3794	29.040
1.3595	17.373	1.3645	20.406	1.3695	23.369	1.3745	26.265	1.3795	29.096
1.3596	17.434	1.3646	20.466	1.3696	23.427	1.3746	26.322	1.3796	29.152
1.3597	17.496	1.3647	20.525	1.3697	23.486	1.3747	26.379	1.3797	29.208
1.3598	17.557	1.3648	20.585	1.3698	23.544	1.3748	26.436	1.3798	29.264
1.3599	17.618	1.3649	20.645	1.3699	23.603	1.3749	26.493	1.3799	29.320
1.3600	17.679	1.3650	20.705	1.3700	23.661	1.3750	26.551	1.3800	29.376
1.3601	17.741	1.3651	20.765	1.3701	23.720	1.3751	26.608	1.3801	29.432
1.3602	17.802	1.3652	20.825	1.3702	23.778	1.3752	26.665	1.3802	29.488
1.3603	17.863	1.3653	20.884	1.3703	23.836	1.3753	26.722	1.3803	29.544
1.3604	17.924	1.3654	20.944	1.3704	23.895	1.3754	26.779	1.3804	29.600
1.3605	17.985	1.3655	21.004	1.3705	23.953	1.3755	26.836	1.3805	29.655
1.3606	18.046	1.3656	21.063	1.3706	24.011	1.3756	26.893	1.3806	29.711
1.3607	18.107	1.3657	21.123	1.3707	24.070	1.3757	26.950	1.3807	29.767
1.3608	18.168	1.3658	21.183	1.3708	24.128	1.3758	27.007	1.3808	29.823
1.3609	18.229	1.3659	21.242	1.3709	24.186	1.3759	27.064	1.3809	29.878
1.3610	18.290	1.3660	21.302	1.3710	24.244	1.3760	27.121	1.3810	29.934
1.3611	18.351	1.3661	21.361	1.3711	24.302	1.3761	27.178	1.3811	29.989
1.3612	18.412	1.3662	21.421	1.3712	24.361	1.3762	27.234	1.3812	30.045
1.3613	18.473	1.3663	21.480	1.3713	24.419	1.3763	27.291	1.3813	30.101
1.3614	18.534	1.3664	21.540	1.3714	24.477	1.3764	27.348	1.3814	30.156
1.3615	18.595	1.3665	21.599	1.3715	24.535	1.3765	27.405	1.3815	30.212
1.3616	18.655	1.3666	21.658	1.3716	24.593	1.3766	27.462	1.3816	30.267
1.3617	18.716	1.3667	21.718	1.3717	24.651	1.3767	27.518	1.3817	30.323
1.3618	18.777	1.3668	21.777	1.3718	24.709	1.3768	27.575	1.3818	30.378
1.3619	18.837	1.3669	21.836	1.3719	24.767	1.3769	27.632	1.3819	30.434
1.3620	18.898	1.3670	21.896	1.3720	24.825	1.3770	27.688	1.3820	30.489
1.3621	18.959	1.3671	21.955	1.3721	24.883	1.3771	27.745	1.3821	30.544
1.3622	19.019	1.3672	22.014	1.3722	24.941	1.3772	27.802	1.3822	30.600
1.3623	19.080	1.3673	22.073	1.3723	24.998	1.3773	27.858	1.3823	30.655
1.3624	19.141	1.3674	22.132	1.3724	25.056	1.3774	27.915	1.3824	30.711
1.3625	19.201	1.3675	22.192	1.3725	25.114	1.3775	27.971	1.3825	30.766
1.3626	19.262	1.3676	22.251	1.3726	25.172	1.3776	28.028	1.3826	30.821
1.3627	19.322	1.3677	22.310	1.3727	25.230	1.3777	28.084	1.3827	30.876
1.3628	19.382	1.3678	22.369	1.3728	25.287	1.3778	28.141	1.3828	30.932
1.3629	19.443	1.3679	22.428	1.3729	25.345	1.3779	28.197	1.3829	30.987

(Continued)

970.91 Refractive Indices (n) of sucrose solutions at 20°—Continued.

n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %
1.3830	31.042	1.3880	33.771	1.3930	36.442	1.3980	39.059	1.4030	41.623
1.3831	31.097	1.3881	33.825	1.3931	36.495	1.3981	39.111	1.4031	41.674
1.3832	31.152	1.3882	33.879	1.3932	36.548	1.3982	39.163	1.4032	41.725
1.3833	31.207	1.3883	33.933	1.3933	36.601	1.3983	39.214	1.4033	41.776
1.3834	31.262	1.3884	33.987	1.3934	36.654	1.3984	39.266	1.4034	41.826
1.3835	31.317	1.3885	34.040	1.3935	36.706	1.3985	39.318	1.4035	41.877
1.3836	31.372	1.3886	34.094	1.3936	36.759	1.3986	39.370	1.4036	41.928
1.3837	31.428	1.3887	34.148	1.3937	36.812	1.3987	39.421	1.4037	41.978
1.3838	31.482	1.3888	34.202	1.3938	36.865	1.3988	39.473	1.4038	42.029
1.3839	31.537	1.3889	34.256	1.3939	36.917	1.3989	39.525	1.4039	42.080
1.3840	31.592	1.3890	34.310	1.3940	36.970	1.3990	39.576	1.4040	42.130
1.3841	31.647	1.3891	34.363	1.3941	37.023	1.3991	39.628	1.4041	42.181
1.3842	31.702	1.3892	34.417	1.3942	37.075	1.3992	39.679	1.4042	42.231
1.3843	31.757	1.3893	34.471	1.3943	37.128	1.3993	39.731	1.4043	42.282
1.3844	31.812	1.3894	34.524	1.3944	37.180	1.3994	39.782	1.4044	42.332
1.3845	31.867	1.3895	34.578	1.3945	37.233	1.3995	39.834	1.4045	42.383
1.3846	31.922	1.3896	34.632	1.3946	37.286	1.3996	39.885	1.4046	42.433
1.3847	31.976	1.3897	34.685	1.3947	37.338	1.3997	39.937	1.4047	42.484
1.3848	32.031	1.3898	34.739	1.3948	37.391	1.3998	39.988	1.4048	42.534
1.3849	32.086	1.3899	34.793	1.3949	37.443	1.3999	40.040	1.4049	42.585
1.3850	32.140	1.3900	34.846	1.3950	37.495	1.4000	40.091	1.4050	42.635
1.3851	32.195	1.3901	34.900	1.3951	37.548	1.4001	40.142	1.4051	42.685
1.3852	32.250	1.3902	34.953	1.3952	37.600	1.4002	40.194	1.4052	42.736
1.3853	32.304	1.3903	35.007	1.3953	37.653	1.4003	40.245	1.4053	42.786
1.3854	32.359	1.3904	35.060	1.3954	37.705	1.4004	40.296	1.4054	42.836
1.3855	32.414	1.3905	35.114	1.3955	37.757	1.4005	40.348	1.4055	42.887
1.3856	32.468	1.3906	35.167	1.3956	37.810	1.4006	40.399	1.4056	42.937
1.3857	32.523	1.3907	35.220	1.3957	37.862	1.4007	40.450	1.4057	42.987
1.3858	32.577	1.3908	35.274	1.3958	37.914	1.4008	40.501	1.4058	43.037
1.3859	32.632	1.3909	35.327	1.3959	37.967	1.4009	40.553	1.4059	43.088
1.3860	32.686	1.3910	35.380	1.3960	38.019	1.4010	40.604	1.4060	43.138
1.3861	32.741	1.3911	35.434	1.3961	38.071	1.4011	40.655	1.4061	43.188
1.3862	32.795	1.3912	35.487	1.3962	38.123	1.4012	40.706	1.4062	43.238
1.3863	32.849	1.3913	35.540	1.3963	38.175	1.4013	40.757	1.4063	43.288
1.3864	32.904	1.3914	35.593	1.3964	38.228	1.4014	40.808	1.4064	43.338
1.3865	32.958	1.3915	35.647	1.3965	38.280	1.4015	40.860	1.4065	43.388
1.3866	33.013	1.3916	35.700	1.3966	38.332	1.4016	40.911	1.4066	43.439
1.3867	33.067	1.3917	35.753	1.3967	38.384	1.4017	40.962	1.4067	43.489
1.3868	33.121	1.3918	35.806	1.3968	38.436	1.4018	41.013	1.4068	43.539
1.3869	33.175	1.3919	35.859	1.3969	38.488	1.4019	41.064	1.4069	43.589
1.3870	33.230	1.3920	35.912	1.3970	38.540	1.4020	41.115	1.4070	43.639
1.3871	33.284	1.3921	35.966	1.3971	38.592	1.4021	41.166	1.4071	43.689
1.3872	33.338	1.3922	36.019	1.3972	38.644	1.4022	41.217	1.4072	43.739
1.3873	33.392	1.3923	36.072	1.3973	38.696	1.4023	41.268	1.4073	43.789
1.3874	33.446	1.3924	36.125	1.3974	38.748	1.4024	41.318	1.4074	43.838
1.3875	33.500	1.3925	36.178	1.3975	38.800	1.4025	41.369	1.4075	43.888
1.3876	33.555	1.3926	36.231	1.3976	38.852	1.4026	41.420	1.4076	43.938
1.3877	33.609	1.3927	36.284	1.3977	38.904	1.4027	41.471	1.4077	43.988
1.3878	33.663	1.3928	36.337	1.3978	38.955	1.4028	41.522	1.4078	44.038
1.3879	33.717	1.3929	36.389	1.3979	39.007	1.4029	41.573	1.4079	44.088

(Continued)

Refractive Indices (*n*) of sucrose solutions at 20°—Continued.

<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %
1.4080	44.138	1.4130	46.604	1.4180	49.023	1.4230	51.399	1.4280	53.733
1.4081	44.187	1.4131	46.652	1.4181	49.071	1.4231	51.446	1.4281	53.779
1.4082	44.237	1.4132	46.701	1.4182	49.119	1.4232	51.493	1.4282	53.825
1.4083	44.287	1.4133	46.750	1.4183	49.167	1.4233	51.540	1.4283	53.871
1.4084	44.337	1.4134	46.799	1.4184	49.215	1.4234	51.587	1.4284	53.918
1.4085	44.386	1.4135	46.848	1.4185	49.263	1.4235	51.634	1.4285	53.964
1.4086	44.436	1.4136	46.896	1.4186	49.311	1.4236	51.681	1.4286	54.010
1.4087	44.486	1.4137	46.945	1.4187	49.359	1.4237	51.728	1.4287	54.056
1.4088	44.535	1.4138	46.994	1.4188	49.407	1.4238	51.775	1.4288	54.102
1.4089	44.585	1.4139	47.043	1.4189	49.454	1.4239	51.822	1.4289	54.148
1.4090	44.635	1.4140	47.091	1.4190	49.502	1.4240	51.869	1.4290	54.194
1.4091	44.684	1.4141	47.140	1.4191	49.550	1.4241	51.916	1.4291	54.241
1.4092	44.734	1.4142	47.188	1.4192	49.598	1.4242	51.963	1.4292	54.287
1.4093	44.783	1.4143	47.237	1.4193	49.645	1.4243	52.010	1.4293	54.333
1.4094	44.833	1.4144	47.286	1.4194	49.693	1.4244	52.057	1.4294	54.379
1.4095	44.882	1.4145	47.334	1.4195	49.741	1.4245	52.104	1.4295	54.425
1.4096	44.932	1.4146	47.383	1.4196	49.788	1.4246	52.150	1.4296	54.471
1.4097	44.981	1.4147	47.431	1.4197	49.836	1.4247	52.197	1.4297	54.517
1.4098	45.031	1.4148	47.480	1.4198	49.884	1.4248	52.244	1.4298	54.563
1.4099	45.080	1.4149	47.528	1.4199	49.931	1.4249	52.291	1.4299	54.609
1.4100	45.130	1.4150	47.577	1.4200	49.979	1.4250	52.338	1.4300	54.655
1.4101	45.179	1.4151	47.625	1.4201	50.027	1.4251	52.384	1.4301	54.701
1.4102	45.228	1.4152	47.674	1.4202	50.074	1.4252	52.431	1.4302	54.746
1.4103	45.278	1.4153	47.722	1.4203	50.122	1.4253	52.478	1.4303	54.792
1.4104	45.327	1.4154	47.771	1.4204	50.169	1.4254	52.524	1.4304	54.838
1.4105	45.376	1.4155	47.819	1.4205	50.217	1.4255	52.571	1.4305	54.884
1.4106	45.426	1.4156	47.868	1.4206	50.264	1.4256	52.618	1.4306	54.930
1.4107	45.475	1.4157	47.916	1.4207	50.312	1.4257	52.664	1.4307	54.976
1.4108	45.524	1.4158	47.964	1.4208	50.359	1.4258	52.711	1.4308	55.022
1.4109	45.574	1.4159	48.013	1.4209	50.407	1.4259	52.758	1.4309	55.067
1.4110	45.623	1.4160	48.061	1.4210	50.454	1.4260	52.804	1.4310	55.113
1.4111	45.672	1.4161	48.109	1.4211	50.502	1.4261	52.851	1.4311	55.159
1.4112	45.721	1.4162	48.158	1.4212	50.549	1.4262	52.897	1.4312	55.205
1.4113	45.770	1.4163	48.206	1.4213	50.596	1.4263	52.944	1.4313	55.250
1.4114	45.820	1.4164	48.254	1.4214	50.644	1.4264	52.990	1.4314	55.296
1.4115	45.869	1.4165	48.302	1.4215	50.691	1.4265	53.037	1.4315	55.342
1.4116	45.918	1.4166	48.350	1.4216	50.738	1.4266	53.083	1.4316	55.388
1.4117	45.967	1.4167	48.399	1.4217	50.786	1.4267	53.130	1.4317	55.433
1.4118	46.016	1.4168	48.447	1.4218	50.833	1.4268	53.176	1.4318	55.479
1.4119	46.065	1.4169	48.495	1.4219	50.880	1.4269	53.223	1.4319	55.524
1.4120	46.114	1.4170	48.543	1.4220	50.928	1.4270	53.269	1.4320	55.570
1.4121	46.163	1.4171	48.591	1.4221	50.975	1.4271	53.316	1.4321	55.616
1.4122	46.212	1.4172	48.639	1.4222	51.022	1.4272	53.362	1.4322	55.661
1.4123	46.261	1.4173	48.687	1.4223	51.069	1.4273	53.408	1.4323	55.707
1.4124	46.310	1.4174	48.735	1.4224	51.116	1.4274	53.455	1.4324	55.752
1.4125	46.359	1.4175	48.784	1.4225	51.164	1.4275	53.501	1.4325	55.797
1.4126	46.408	1.4176	48.832	1.4226	51.211	1.4276	53.548	1.4326	55.844
1.4127	46.457	1.4177	48.880	1.4227	51.258	1.4277	53.594	1.4327	55.889
1.4128	46.506	1.4178	48.928	1.4228	51.305	1.4278	53.640	1.4328	55.935
1.4129	46.555	1.4179	48.976	1.4229	51.352	1.4279	53.686	1.4329	55.980

(Continued)

Refractive Indices (*n*) of sucrose solutions at 20°—Continued.

<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %	<i>n</i> 20°	Sucrose, %
1.4330	56.026	1.4380	58.279	1.4430	60.496	1.4480	62.677	1.4530	64.823
1.4331	56.071	1.4381	58.324	1.4431	60.540	1.4481	62.720	1.4531	64.865
1.4332	56.116	1.4382	58.369	1.4432	60.584	1.4482	62.763	1.4532	64.908
1.4333	56.162	1.4383	58.413	1.4433	60.628	1.4483	62.806	1.4533	64.950
1.4334	56.207	1.4384	58.458	1.4434	60.672	1.4484	62.849	1.4534	64.993
1.4335	56.253	1.4385	58.503	1.4435	60.716	1.4485	62.893	1.4535	65.035
1.4336	56.298	1.4386	58.547	1.4436	60.759	1.4486	62.936	1.4536	65.078
1.4337	56.343	1.4387	58.592	1.4437	60.803	1.4487	62.979	1.4537	65.120
1.4338	56.389	1.4388	58.637	1.4438	60.847	1.4488	63.022	1.4538	65.163
1.4339	56.434	1.4389	58.681	1.4439	60.891	1.4489	63.065	1.4539	65.205
1.4340	56.479	1.4390	58.726	1.4440	60.935	1.4490	63.108	1.4540	65.248
1.4341	56.525	1.4391	58.770	1.4441	60.979	1.4491	63.152	1.4541	65.290
1.4342	56.570	1.4392	58.815	1.4442	61.023	1.4492	63.195	1.4542	65.333
1.4343	56.615	1.4393	58.859	1.4443	61.066	1.4493	63.238	1.4543	65.375
1.4344	56.660	1.4394	58.904	1.4444	61.110	1.4494	63.281	1.4544	65.417
1.4345	56.706	1.4395	58.948	1.4445	61.154	1.4495	63.324	1.4545	65.460
1.4346	56.751	1.4396	58.993	1.4446	61.198	1.4496	63.367	1.4546	65.502
1.4347	56.796	1.4397	59.037	1.4447	61.241	1.4497	63.410	1.4547	65.544
1.4348	56.841	1.4398	59.082	1.4448	61.285	1.4498	63.453	1.4548	65.587
1.4349	56.887	1.4399	59.126	1.4449	61.329	1.4499	63.496	1.4549	65.629
1.4350	56.932	1.4400	59.170	1.4450	61.372	1.4500	63.539	1.4550	65.672
1.4351	56.977	1.4401	59.215	1.4451	61.416	1.4501	63.582	1.4551	65.714
1.4352	57.022	1.4402	59.259	1.4452	61.460	1.4502	63.625	1.4552	65.756
1.4353	57.067	1.4403	59.304	1.4453	61.503	1.4503	63.668	1.4553	65.798
1.4354	57.112	1.4404	59.348	1.4454	61.547	1.4504	63.711	1.4554	65.841
1.4355	57.157	1.4405	59.392	1.4455	61.591	1.4505	63.754	1.4555	65.883
1.4356	57.202	1.4406	59.437	1.4456	61.634	1.4506	63.797	1.4556	65.925
1.4357	57.247	1.4407	59.481	1.4457	61.678	1.4507	63.840	1.4557	65.967
1.4358	57.292	1.4408	59.525	1.4458	61.721	1.4508	63.882	1.4558	66.010
1.4359	57.337	1.4409	59.569	1.4459	61.765	1.4509	63.925	1.4559	66.052
1.4360	57.382	1.4410	59.614	1.4460	61.809	1.4510	63.968	1.4560	66.094
1.4361	57.427	1.4411	59.658	1.4461	61.852	1.4511	64.011	1.4561	66.136
1.4362	57.472	1.4412	59.702	1.4462	61.896	1.4512	64.054	1.4562	66.178
1.4363	57.517	1.4413	59.746	1.4463	61.939	1.4513	64.097	1.4563	66.221
1.4364	57.562	1.4414	59.791	1.4464	61.983	1.4514	64.139	1.4564	66.263
1.4365	57.607	1.4415	59.835	1.4465	62.026	1.4515	64.182	1.4565	66.305
1.4366	57.652	1.4416	59.879	1.4466	62.070	1.4516	64.225	1.4566	66.347
1.4367	57.697	1.4417	59.923	1.4467	62.113	1.4517	64.268	1.4567	66.389
1.4368	57.742	1.4418	59.967	1.4468	62.156	1.4518	64.311	1.4568	66.431
1.4369	57.787	1.4419	60.011	1.4469	62.200	1.4519	64.353	1.4569	66.473
1.4370	57.832	1.4420	60.056	1.4470	62.243	1.4520	64.396	1.4570	66.515
1.4371	57.877	1.4421	60.100	1.4471	62.287	1.4521	64.439	1.4571	66.557
1.4372	57.921	1.4422	60.144	1.4472	62.330	1.4522	64.481	1.4572	66.599
1.4373	57.966	1.4423	60.188	1.4473	62.373	1.4523	64.524	1.4573	66.641
1.4374	58.011	1.4424	60.232	1.4474	62.417	1.4524	64.567	1.4574	66.683
1.4375	58.056	1.4425	60.276	1.4475	62.460	1.4525	64.609	1.4575	66.725
1.4376	58.101	1.4426	60.320	1.4476	62.503	1.4526	64.652	1.4576	66.767
1.4377	58.145	1.4427	60.364	1.4477	62.547	1.4527	64.695	1.4577	66.809
1.4378	58.190	1.4428	60.408	1.4478	62.590	1.4528	64.737	1.4578	66.851
1.4379	58.235	1.4429	60.452	1.4479	62.633	1.4529	64.780	1.4579	66.893

(Continued)

Refractive Indices (n) of sucrose solutions at 20°—Continued.

n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %
1.4580	66.935	1.4630	69.016	1.4680	71.065	1.4730	73.084	1.4780	75.074
1.4581	66.977	1.4631	69.057	1.4681	71.106	1.4731	73.124	1.4781	75.114
1.4582	67.019	1.4632	69.098	1.4682	71.146	1.4732	73.164	1.4782	75.153
1.4583	67.061	1.4633	69.139	1.4683	71.187	1.4733	73.204	1.4783	75.193
1.4584	67.103	1.4634	69.181	1.4684	71.228	1.4734	73.244	1.4784	75.232
1.4585	67.145	1.4635	69.222	1.4685	71.268	1.4735	73.285	1.4785	75.272
1.4586	67.186	1.4636	69.263	1.4686	71.309	1.4736	73.325	1.4786	75.311
1.4587	67.228	1.4637	69.304	1.4687	71.349	1.4737	73.365	1.4787	75.350
1.4588	67.270	1.4638	69.346	1.4688	71.390	1.4738	73.405	1.4788	75.390
1.4589	67.312	1.4639	69.387	1.4689	71.431	1.4739	73.445	1.4789	75.429
1.4590	67.354	1.4640	69.428	1.4690	71.471	1.4740	73.485	1.4790	75.469
1.4591	67.396	1.4641	69.469	1.4691	71.512	1.4741	73.524	1.4791	75.508
1.4592	67.437	1.4642	69.510	1.4692	71.552	1.4742	73.564	1.4792	75.547
1.4593	67.479	1.4643	69.551	1.4693	71.593	1.4743	73.604	1.4793	75.587
1.4594	67.521	1.4644	69.593	1.4694	71.633	1.4744	73.644	1.4794	75.626
1.4595	67.563	1.4645	69.634	1.4695	71.674	1.4745	73.684	1.4795	75.666
1.4596	67.604	1.4646	69.675	1.4696	71.714	1.4746	73.724	1.4796	75.705
1.4597	67.646	1.4647	69.716	1.4697	71.755	1.4747	73.764	1.4797	75.744
1.4598	67.688	1.4648	69.757	1.4698	71.795	1.4748	73.804	1.4798	75.784
1.4599	67.729	1.4649	69.798	1.4699	71.836	1.4749	73.844	1.4799	75.823
1.4600	67.771	1.4650	69.839	1.4700	71.876	1.4750	73.884	1.4800	75.862
1.4601	67.813	1.4651	69.880	1.4701	71.917	1.4751	73.924	1.4801	75.901
1.4602	67.854	1.4652	69.921	1.4702	71.957	1.4752	73.963	1.4802	75.941
1.4603	67.896	1.4653	69.962	1.4703	71.998	1.4753	74.003	1.4803	75.980
1.4604	67.938	1.4654	70.003	1.4704	72.038	1.4754	74.043	1.4804	76.019
1.4605	67.979	1.4655	70.044	1.4705	72.078	1.4755	74.083	1.4805	76.058
1.4606	68.021	1.4656	70.085	1.4706	72.119	1.4756	74.123	1.4806	76.098
1.4607	68.063	1.4657	70.126	1.4707	72.159	1.4757	74.162	1.4807	76.137
1.4608	68.104	1.4658	70.167	1.4708	72.199	1.4758	74.202	1.4808	76.176
1.4609	68.146	1.4659	70.208	1.4709	72.240	1.4759	74.242	1.4809	76.215
1.4610	68.187	1.4660	70.249	1.4710	72.280	1.4760	74.282	1.4810	76.254
1.4611	68.229	1.4661	70.290	1.4711	72.320	1.4761	74.321	1.4811	76.294
1.4612	68.270	1.4662	70.331	1.4712	72.361	1.4762	74.361	1.4812	76.333
1.4613	68.312	1.4663	70.372	1.4713	72.401	1.4763	74.401	1.4813	76.372
1.4614	68.353	1.4664	70.413	1.4714	72.441	1.4764	74.441	1.4814	76.411
1.4615	68.395	1.4665	70.453	1.4715	72.482	1.4765	74.480	1.4815	76.450
1.4616	68.436	1.4666	70.494	1.4716	72.522	1.4766	74.520	1.4816	76.489
1.4617	68.478	1.4667	70.535	1.4717	72.562	1.4767	74.560	1.4817	76.528
1.4618	68.519	1.4668	70.576	1.4718	72.602	1.4768	74.599	1.4818	76.567
1.4619	68.561	1.4669	70.617	1.4719	72.643	1.4769	74.639	1.4819	76.607
1.4620	68.602	1.4670	70.658	1.4720	72.683	1.4770	74.678	1.4820	76.646
1.4621	68.643	1.4671	70.698	1.4721	72.723	1.4771	74.718	1.4821	76.685
1.4622	68.685	1.4672	70.739	1.4722	72.763	1.4772	74.758	1.4822	76.724
1.4623	68.726	1.4673	70.780	1.4723	72.803	1.4773	74.797	1.4823	76.763
1.4624	68.768	1.4674	70.821	1.4724	72.843	1.4774	74.837	1.4824	76.802
1.4625	68.809	1.4675	70.861	1.4725	72.884	1.4775	74.876	1.4825	76.841
1.4626	68.850	1.4676	70.902	1.4726	72.924	1.4776	74.916	1.4826	76.880
1.4627	68.892	1.4677	70.943	1.4727	72.964	1.4777	74.956	1.4827	76.919
1.4628	68.933	1.4678	70.984	1.4728	73.004	1.4778	74.995	1.4828	76.958
1.4629	68.974	1.4679	71.024	1.4729	73.044	1.4779	75.035	1.4829	76.997

(Continued)

970.91 Refractive Indices (n) of sucrose solutions at 20°—Concluded.

n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %	n 20°	Sucrose, %
1.4830	77.036	1.4880	78.969	1.4930	80.876	1.4980	82.755	1.5030	84.609
1.4831	77.075	1.4881	79.008	1.4931	80.913	1.4981	82.793	1.5031	84.646
1.4832	77.113	1.4882	79.046	1.4932	80.951	1.4982	82.830	1.5032	84.682
1.4833	77.152	1.4883	79.084	1.4933	80.989	1.4983	82.867	1.5033	84.719
1.4834	77.191	1.4884	79.123	1.4934	81.027	1.4984	82.905	1.5034	84.756
1.4835	77.230	1.4885	79.161	1.4935	81.065	1.4985	82.942	1.5035	84.792
1.4836	77.269	1.4886	79.199	1.4936	81.103	1.4986	82.979	1.5036	84.829
1.4837	77.308	1.4887	79.238	1.4937	81.140	1.4987	83.016	1.5037	84.866
1.4838	77.347	1.4888	79.276	1.4938	81.178	1.4988	83.054	1.5038	84.903
1.4839	77.386	1.4889	79.314	1.4939	81.216	1.4989	83.091	1.5039	84.939
1.4840	77.425	1.4890	79.353	1.4940	81.254	1.4990	83.128	1.5040	84.976
1.4841	77.463	1.4891	79.391	1.4941	81.291	1.4991	83.165	1.5041	85.013
1.4842	77.502	1.4892	79.429	1.4942	81.329	1.4992	83.202	1.5042	85.049
1.4843	77.541	1.4893	79.468	1.4943	81.367	1.4993	83.240	1.5043	85.086
1.4844	77.580	1.4894	79.506	1.4944	81.405	1.4994	83.277	1.5044	85.123
1.4845	77.619	1.4895	79.544	1.4945	81.442	1.4995	83.314	1.5045	85.159
1.4846	77.657	1.4896	79.582	1.4946	81.480	1.4996	83.351	1.5046	85.196
1.4847	77.696	1.4897	79.620	1.4947	81.518	1.4997	83.388	1.5047	85.233
1.4848	77.735	1.4898	79.659	1.4948	81.555	1.4998	83.425	1.5048	85.269
1.4849	77.774	1.4899	79.697	1.4949	81.593	1.4999	83.463	1.5049	85.306
1.4850	77.812	1.4900	79.735	1.4950	81.631	1.5000	83.500	1.5050	85.343
1.4851	77.851	1.4901	79.773	1.4951	81.668	1.5001	83.537	1.5051	85.379
1.4852	77.890	1.4902	79.811	1.4952	81.706	1.5002	83.574	1.5052	85.416
1.4853	77.928	1.4903	79.850	1.4953	81.744	1.5003	83.611	1.5053	85.452
1.4854	77.967	1.4904	79.888	1.4954	81.781	1.5004	83.648	1.5054	85.489
1.4855	78.006	1.4905	79.926	1.4955	81.819	1.5005	83.686	1.5055	85.525
1.4856	78.045	1.4906	79.964	1.4956	81.856	1.5006	83.722	1.5056	85.562
1.4857	78.083	1.4907	80.002	1.4957	81.894	1.5007	83.759	1.5057	85.598
1.4858	78.122	1.4908	80.040	1.4958	81.932	1.5008	83.796	1.5058	85.635
1.4859	78.160	1.4909	80.078	1.4959	81.969	1.5009	83.833	1.5059	85.672
1.4860	78.199	1.4910	80.116	1.4960	82.007	1.5010	83.870	1.5060	85.708
1.4861	78.238	1.4911	80.154	1.4961	82.044	1.5011	83.907	1.5061	85.744
1.4862	78.276	1.4912	80.192	1.4962	82.082	1.5012	83.944	1.5062	85.781
1.4863	78.315	1.4913	80.231	1.4963	82.119	1.5013	83.981	1.5063	85.817
1.4864	78.353	1.4914	80.269	1.4964	82.157	1.5014	84.018	1.5064	85.854
1.4865	78.392	1.4915	80.307	1.4965	82.194	1.5015	84.055	1.5065	85.890
1.4866	78.431	1.4916	80.345	1.4966	82.232	1.5016	84.092	1.5066	85.927
1.4867	78.469	1.4917	80.383	1.4967	82.269	1.5017	84.129	1.5067	85.963
1.4868	78.508	1.4918	80.421	1.4968	82.307	1.5018	84.166	1.5068	86.000
1.4869	78.546	1.4919	80.459	1.4969	82.344	1.5019	84.203	1.5069	86.036
1.4870	78.585	1.4920	80.497	1.4970	82.381	1.5020	84.240	1.5070	86.072
1.4871	78.623	1.4921	80.534	1.4971	82.419	1.5021	84.277	1.5071	86.109
1.4872	78.662	1.4922	80.572	1.4972	82.456	1.5022	84.314	1.5072	86.145
1.4873	78.700	1.4923	80.610	1.4973	82.494	1.5023	84.351	1.5073	86.182
1.4874	78.739	1.4924	80.648	1.4974	82.531	1.5024	84.388	1.5074	86.218
1.4875	78.777	1.4925	80.686	1.4975	82.569	1.5025	84.424	1.5075	86.254
1.4876	78.816	1.4926	80.724	1.4976	82.606	1.5026	84.461	1.5076	86.291
1.4877	78.854	1.4927	80.762	1.4977	82.643	1.5027	84.498	1.5077	86.327
1.4878	78.892	1.4928	80.800	1.4978	82.681	1.5028	84.535	1.5078	86.363
1.4879	78.931	1.4929	80.838	1.4979	82.718	1.5029	84.572	1.5079	86.399

REFERENCE TABLES

Table for determining per cent sucrose in sugar solutions from readings of Zeiss immersion refractometer at 20°C^a

Reading ^b at 20°	n_D^{20}	Sucrose, %	Reading ^b at 20°	n_D^{20}	Sucrose, %	Reading ^b at 20°	n_D^{20}	Sucrose, %
14.47	1.33299	0	45	1.34453	7.91	76	1.35606	15.24
15	3320	0.15	46	4500	8.15	77	5642	15.47
16	3358	0.41	47	4537	8.39	78	5678	15.69
17	3397	0.68	48	4575	8.64	79	5714	15.91
18	3436	0.94	49	4612	8.89			
19	3474	1.21				80	5750	16.14
			50	4650	9.13	81	5786	16.36
20	3513	1.48	51	4687	9.38	82	5822	16.58
21	3551	1.74	52	4724	9.62	83	5858	16.81
22	3590	2.01	53	4761	9.86	84	5894	17.03
23	3628	2.27	54	4798	10.10	85	5930	17.25
24	3667	2.54	55	4836	10.34	86	5966	17.47
25	3705	2.80	56	4873	10.58	87	6002	17.69
26	3743	3.07	57	4910	10.82	88	6038	17.91
27	3781	3.33	58	4947	11.06	89	6074	18.12
28	3820	3.59	59	4984	11.30			
29	3858	3.85				90	6109	18.34
			60	5021	11.54	91	6145	18.56
30	3896	4.11	61	5058	11.78	92	6181	18.78
31	3934	4.36	62	5095	12.01	93	6217	19.00
32	3972	4.62	63	5132	12.25	94	6252	19.21
33	4010	4.88	64	5169	12.48	95	6287	19.42
34	4048	5.14	65	5205	12.72	96	6323	19.63
35	4086	5.40	66	5242	12.95	97	6359	19.85
36	4124	5.65	67	5279	13.18	98	6394	20.06
37	4162	5.91	68	5316	13.41	99	6429	20.27
38	4199	6.16	69	5352	13.64			
39	4237	6.41				100	6464	20.48
			70	5388	13.87	101	6500	20.69
40	4275	6.66	71	5425	14.10	102	6535	20.90
41	4313	6.91	72	5461	14.33	103	6570	21.11
42	4350	7.16	73	5497	14.56	104	6606	21.32
43	4388	7.41	74	5533	14.79	105	6640	21.53
44	4426	7.66	75	5569	15.01			

^a Values in this table were calcd by J. A. Mathews from five-place indices of Schönrock as given by Landt, Z. Ver. Deut. Zucker-Ind. 83, 692(1933).

^b Scale readings refer only to scale of arbitrary units proposed by Pulfrich, Z. Angew. Chem. 1168(1899). According to this scale 14.5 = 1.33300, 50.0 = 1.34650, and 100.0 = 1.36454. If immersion refractometer used is calibrated according to another arbitrary scale, readings must be converted into refractive indices before this table is used to determine per cent sugar.



Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010. ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1970.

ESA's objectives are:-

- ❖ Develop Ethiopian standards and establish a system that enable to check weather goods and services are in compliance with the required standards,
- ❖ Facilitate the country's technology transfer through the use of standards,
- ❖ Develop national standards for local products and services so as to make them competitive in the international market.

Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational Institutions, research institutes, government organizations, certification, inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes.

Orders for all Ethiopian Standards, International Standard and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices. A catalogue of Ethiopian Standards is also available freely and can be accessed in from our website.

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